

We Claim:

1. A method of welding two pieces of metal to produce a weld joint comprised of a center-weld and a surface-weld, and having a specified thickness and optimized fracture toughness for an intended application, said method comprising the steps of:
 - (a) selecting a first non-destructive examination technique that is suitable for detecting surface-breaking discontinuities in a metal used in said intended application;
 - (b) determining a minimum surface-breaking discontinuity through-thickness dimension that is readily detectable by said first non-destructive examination technique;
 - (c) selecting a second non-destructive examination technique that is suitable for detecting embedded discontinuities in a metal used in said intended application;
 - (d) determining a minimum embedded discontinuity through-thickness dimension that is readily detectable by said second non-destructive examination technique;
 - (e) determining a first toughness value that is adequate to substantially prevent fracture initiation in said weld joint from surface-breaking discontinuities having a through-thickness dimension that is substantially equal to said minimum surface-breaking discontinuity through-thickness dimension and a second toughness value that is adequate to substantially prevent fracture initiation in said weld joint from embedded discontinuities having a through-thickness dimension that is substantially equal to said minimum embedded discontinuity through thickness dimension;
 - (f) designing a surface-weld welding procedure that will produce a surface-weld having a toughness value substantially equal to or greater than said first toughness value and a center-weld welding procedure that will produce a center-weld having a toughness value substantially equal to or greater than said second toughness

value;

(g) creating said center-weld using said center-weld welding procedure; and

(h) creating said surface-weld using said surface-weld welding procedure.

2. A weld joint having optimized fracture toughness for an intended application, said weld joint having been produced by a method of welding two pieces of metal to produce said weld joint, wherein said weld joint is comprised of a center-weld and a surface-weld and has a specified thickness, and said method comprises the steps of:

(a) selecting a first non-destructive examination technique that is suitable for detecting surface-breaking discontinuities in a metal used in said intended application;

(b) determining a minimum surface-breaking discontinuity through-thickness dimension that is readily detectable by said first non-destructive examination technique;

(c) selecting a second non-destructive examination technique that is suitable for detecting embedded discontinuities in a metal used in said intended application;

(d) determining a minimum embedded discontinuity through-thickness dimension that is readily detectable by said second non-destructive examination technique;

(e) determining a first toughness value that is adequate to substantially prevent fracture initiation in said weld joint from surface-breaking discontinuities having a through-thickness dimension that is substantially equal to said minimum surface-breaking discontinuity through-thickness dimension and a second toughness value that is adequate to substantially prevent fracture initiation in said weld joint from embedded discontinuities having a through-thickness dimension that is substantially equal to said minimum embedded discontinuity through thickness

dimension;

(f) designing a surface-weld welding procedure that will produce a surface-weld having a toughness value substantially equal to or greater than said first toughness value and a center-weld welding procedure that will produce a center-weld having a toughness value substantially equal to or greater than said second toughness value;

(g) creating said center-weld using said center-weld welding procedure; and

(h) creating said surface-weld using said surface-weld welding procedure.